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HANDLING ARTIFICIAL VARIABLES IN
A SIMPLEX METHOD: A COMMENTARY

by

A. Charnes
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November 1981

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Handling Artificial Variables in A Simplex Method: A Commentary

by A. Charnes and W.W. Cooper

Charnes' non-Archimedean Simplex method is unfortunately misrepresented in the paper by P. Jolly "Handling Artificial Variables in the Simplex Method", JIOS, v. 2 (1981), No. 3, pp. 241-248, possibly because he refers to books by Gass [1], 1969, and Hadley [2], 1973, rather than to a correct description as in Charnes and Cooper [3], 1961.

The latter, available as a text, describes the treatment in detail, see also Charnes, Cooper and Henderson [4], 1953, although the general format has been available since the original publication by Charnes in Econometrica [5], 1952. Thus, referring to the former, the use of the non-Archimedean transcendental M can be accomplished by calculation solely in the base field by use of two rows for the $(z_j - c_j)$, one of which contains the coefficients of M. There is thus no difficulty with hand computation since each row transfers from one basis to the next as if there were simply one additional row in the tableau.

One could employ this procedure just as well in the machine computation case at the cost of only slightly increasing the machine operations in examining $(z_j - c_j)$-values.
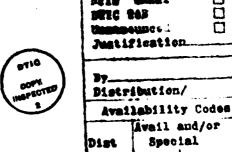
Contrary to Jolly's statements on computational experience attributed to Hadley, the use of "large" numbers for M does not pose substantial difficulties for machine computation, when this course, rather than the a priori exact course above is followed. For sufficiently large numbers one obtains the same optimal solution as if the exact course were followed.

Very often, also, one can identify m -1 structural vectors linearly independent of the right hand side vector P_o. One can then start with these

in a basis of vectors in which P_0 is the <u>only</u> artificial one. Any decent LP code today would take this basis and immediately invert it, thus starting the simplex procedure with only one artificial vector to be removed.

REFERENCES

1. S.I. Gass, <u>Linear Programming, Methods and Applications</u>, McGraw-Hill Kogakusha Ltd, 1969.

2. G. Hadley, <u>Linear Programming</u>, Addison-Wesley, 1973.

3. A Charnes and W.W. Cooper, <u>Management Models and Industrial Applications of Linear Programming</u>, vols. I and II, J. Wiley and Sons, 1961.

4. A Charnes, W.W. Cooper, A. Henderson, <u>An Introduction to Linear Programming</u>, J. Wiley and Sons, 1953.

5. A. Charnes, "Optimality and Degeneracy in Linear Programming", <u>Econometrica</u>, v. 20, No. 2, pp. 160-170, April, 1952.

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Charnes' non-Archimedean simplex method and its computation in terms of Archimedean quantities is developed to correct erroneous statements in the research literature centering around methods of computation involving artificial variables.

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